REMARKS/ARGUMENTS

Claims 1 – 7, 9 – 10, 13 – 17, and 19 – 21 are currently pending in the application, with claims 1 – 6 being withdrawn.

For the reasons set forth below, applicant respectfully requests reconsideration of the claim rejections.

Patentability of the Claims

Claim 7

The droplet generating method described in claim 7 has been amended to point out that a planar heat transducer in the liquid-holding chambers is oriented in a plane that is perpendicular to the trajectory of the liquid that is propelled through the chamber orifice. Amended claim 7 also calls for the step of sizing the heat transducer such that liquid that is propelled from the chamber forms droplets of less than 100 femtoliters in volume.

One exemplary mechanism for carrying out the method of claim 7 is illustrated in Fig. 1 of the present application, which shows in cross section the planar heat transducer 34, which may be a planar thin film resistor as mentioned in paragraph 25 of the application as filed. The transducer is oriented to be in a plane that is perpendicular to the trajectory of liquid that is propelled through the orifice 24.

It is noteworthy that the trajectories of the droplets 36 in Fig. 1 are illustrated at a distance away from the orifice and, although still substantially parallel to the planar transducer, are beginning to diverge. It will be appreciated, however, that the trajectory of propelled liquid as it passes through the orifice is substantially perpendicular to the planar heat transducer in order to be propelled from the chamber 32 through the orifice.

As noted, the claimed sizing of the heat transducer relative to the chamber results in a large vapor bubble (illustrated at 38 in Fig 1) that produces extremely small-volume droplets propelled through the orifice. As noted in paragraph 10 of the application as filed, the particulars of the transducer size and location relative to that of the chamber is not simply a matter of scaling down existing ink-jet drop generators (which produce droplets having droplets of about 4000 femtoliters) because such scaling down would introduce several problems, as discussed in paragraph 11 of the application.

Byron does not teach or suggest a method of configuring a liquid-holding chamber and planar transducer so that droplets are propelled through the orifice along trajectories that are perpendicular to the planar transducer. Rather, Byron essentially wraps a heater around the end of a capillary tube such as shown at 223' in Fig. 4.[1] Consequently, nothing in Byron anticipates claim 7 as amended herein.

With respect to the Wirch device, the only heat transducer mentioned in that reference appears in the embodiment of Fig. 2 as an "*electrical heating element and converter 14*" that is "*mounted to operate with*" a liquid expelling jet. When current is applied to the heating element, via lines 15, a small amount of liquid evaporates "*in an explosion-like fashion so that a liquid volume 16 is expelled from the jet 13.*" (Wirch, Col. 2, lines 42 – 54.)

It is noteworthy that Wirch, in Fig. 3, as discussed in column 2, line 59 – 65, discusses use of a "converter' that bends back and forth at a high frequency for causing a volume of liquid to be expelled from a jet. This bending converter 18 is a piezoelectric device driven to vibrate at a high frequency and, as evidenced by Wirch's own characterization of the device as a bending converter, this device is not at all comparable to a heat transducer for creating explosion-like vapor bubbles for ejecting liquid.

Since nothing in the heat transducer disclosure (Fig. 2) of Wirch mentions a planar heat transducer or its orientation to be perpendicular to the trajectory of an expelled drop, Wirch does not anticipate nor render obvious the subject matter of amended claim 7.

In view of the forgoing, applicant submits that claim 7 and the claims depending therefrom are in condition for allowance.

Claim 15

Independent claim 15 has been amended to specify steps of providing a planar heat transducer within each chamber and orienting that transducer to be substantially perpendicular to the trajectory of liquid that is expelled through the orifice of the chamber. This transducer

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[1] One consequence of the heated-tube-end approach of Byron is the need for ensuring that the liquid held in the tube is under pressure, as by pump 35, or that the tube includes some form of valving (mentioned but not illustrated) to ensure that the volatized liquid expands out of the tube end and not back toward the source.

orientation, as well as its nearness to the orifice, effects separation of the propelled liquid into two or more droplets upon exiting the orifice.

As noted above in connection with the discussion of claim 7, nothing in either Byron or Wirch teaches or suggests the planar heat transducer orientation that is similarly recited in claim 15. Consequently, claim 15 and its dependent claim 16 are also allowable.

Claim 17

This claim has been amended to include the subject matter of now cancelled claim 18. In particular, claim 17, in combination with other limitations, specifies that: "*the distance between the upper surface of the chamber and the outer surface* [of the drop generator head] *is less than 0.75 times the square root of the heat transducer residing in that chamber.*"

In rejecting original claim 18, the Examiner states that "*there appears to be no unobviousness to specific relative dimensions of the chamber.*"

In reply, applicant notes that what is claimed here is not merely a recital of chamber dimensions. Rather, applicant has arrived at and claims a particular relationship between transducer size and chamber height that produces droplets having volumes of less than 100 femtoliters. Moreover, while the prior art discloses a familiarity with desirable size requirements of aerosols intended to be inhaled (such as the observations summarized in paragraph 74 of Byron), none of the references of record remotely suggests the specific relationship defined in the final paragraph of amended claim 17.[2] Accordingly, applicant respectfully and strongly disagrees with the Examiner's statement that what is defined in claim 17 (formerly claim 18) is well within the realm of the artisan of ordinary skill.

Claim 19

This claim has been amended to essentially include the subject matter of now cancelled claims 22 and 23. In particular, the heat-transducer driven inhaler includes a mouthpiece that, in turn, includes a recess (such as shown at reference numeral 61 in Fig. 6). Gas is directed through the recess to entrain the droplets that are propelled into the mouthpiece. No such

[2] Nor, as mentioned earlier, would this relationship be arrived at by merely making smaller the existing heat-transducer-driven drop generators.

combination is identified in the art of record. Accordingly, claim 19 and the claims depending therefrom are believed to be in condition for allowance.

Conclusion

In view of the foregoing, Applicant believes that all of the currently pending claims are in condition for allowance, and an early notification to that effect is respectfully requested. If the Examiner has any questions, he is invited to contact Applicant's attorney at the below-listed telephone number.

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